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INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for October, 1887, and is based upon reports of regular and voluntary observers of both countries. Descriptions of the storms which appeared over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i, on which also appears the distribution of icebergs reported, and the limits of fog-belts to the westward of the fortieth meridian. In tracing the centres of the paths of these storms, data from the reports of two hundred and fifty-one vessels have been used. The most important storm of the month passed eastward from Newfoundland during the 23d, and advanced over the ocean, north of the trans-Atlantic tracks, to the British Isles by the 29th.

When compared with the average for corresponding months of previous years there was a deficiency in the aggregate quantity of ocean ice, reported for October, 1887. There was, also, a marked diminution in the number of fog-banks reported, when compared with reports received for September and the summer months.

The mean temperature of the month is decidedly below the normal in nearly all parts of the country east of the Rocky Mountains, the deficiencies being greatest in the Lake region, where they range from 4° to 8° . In the middle and south Pacific coast regions the month was much warmer than usual for October. In northern California the mean temperature ranges from 4° to 10° above the normal.

The precipitation was excessive in the south Atlantic and east Gulf states; also over several comparatively small areas to the west of the Mississippi, but over the greater part of the country it was deficient, the rainfall in the central valleys being decidedly below the average.

Under the heading "Drought" will be found a table showing the average precipitation in the various districts for the first ten months of the year, with the normals for the corresponding period of former years. It will be seen that thus far the rainfall of 1887 is below the normal in a majority of the districts of the country.

In the preparation of this REVIEW the following data, received up to November 20, 1887, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at 133 Signal Service stations and 22 Canadian stations, as telegraphed to this office; 174 monthly journals and 176 monthly means from the former and 22 monthly means from the latter; 268 monthly registers from voluntary observers; 59 monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" monthly weather reports from the local weather services of Alabama, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, New England, New Jersey, Ohio, Oregon, Pennsylvania, South Carolina, and Tennessee; and the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean pressure for October, 1887, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

The mean pressure for the month is greatest in the northern plateau and north Pacific coast regions, the area of barometric maxima being inclosed by the isobar of 30.15. Within this area a number of stations report mean pressures of 30.18—the maximum for the month. Over the Gulf of Saint Lawrence, southern Florida, and southwestern Arizona, the pressure is slightly below 29.9—the lowest monthly mean reported being 29.84, at Yuma, Ariz. The monthly barometric means range between 30.0 and 30.1 over nearly the whole country, the exceptions being a narrow area extending from Lake Superior eastward to the Atlantic coast, along the southwestern border from western Texas to the Pacific, and in Florida and along the east Gulf coast. The difference between the highest and lowest monthly means reported is .34, which is about the same as the range for the preceding month.

The mean pressure, as compared with that for the preceding month, shows an increase in all districts west of the Mississippi; an increase also occurs in Illinois and Indiana and thence southward to the Gulf coast. The excess over much the greater part of the region mentioned ranges from .05 to .19, the maximum departures occurring in the northern and middle plateau districts. Along the Atlantic coast, and in the Lake region

and Saint Lawrence Valley, the mean pressure is below that for the preceding month, the deficiencies generally ranging from .04 to .08 along the Atlantic coast, and from .08 to .14 in the Lake region.

The departures from the normal October pressure for the various stations are given in the tables of miscellaneous meteorological data; they are also graphically exhibited on chart iii by lines connecting stations of normal or equal abnormal values. From the latter it is shown that the deficiencies occur in southern Arizona and California, and in all districts east of the Mississippi River. The deficiencies in Arizona and California are very slight, not exceeding .04, but in some districts east of the Mississippi they are quite marked, New England and the Canadian Maritime Provinces showing maximum deficiencies ranging from .10 to .13. To the westward of the Mississippi the mean pressure is everywhere above the normal, except in California and southern Arizona, the excess ranging from .10 to .15 in the northern plateau and north Pacific coast regions.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are also given in the tables of miscellaneous meteorological data. To the eastward of the one hundredth meridian the ranges for this month conform, as usual, to the general rule, that is, they increase with the latitude and decrease

slightly, though somewhat irregularly, with increasing longitude until reaching the meridian named. Over the eastern Rocky Mountain districts the ranges first increase with the latitude to the fortieth parallel, and thence decrease with increasing latitude to the northern boundary of the United States. In the states bordering on the Atlantic coast the extreme ranges are .34 at Cedar Keys, Fla., and 1.32 at Eastport, Me.; over the interior of the country, .55 at Shreveport, La., and 1.41 at Saint Vincent, Minn.; on the Pacific coast, .43 at San Francisco, and .86 at Port Angeles, Wash.

In the Rocky Mountain region and extreme northwest the ranges exceed the normal October range by from .3 to .5; elsewhere no marked departures occur.

AREAS OF HIGH PRESSURE.

Six comparatively well-defined areas of high pressure have appeared within or near the field of observation in the United States and the adjacent Canadian frontier during the month. Three of these areas apparently entered Washington Territory from the north Pacific, crossed the country, and passed into the Atlantic from the coasts of North Carolina and the middle Atlantic states.

Two moved southeastward from the western Saskatchewan Valley into the United States, one of which, progressing in the same general direction, reached the Atlantic on the coast of New Jersey, the other, trending northeastward in Nebraska, passed into the Gulf of Saint Lawrence from the northern coast of New Brunswick.

The sixth high area moved from the British Possessions northeast of Manitoba in a generally southwesterly direction toward Texas and New Mexico, and at the close of the month traces of it were still apparent in that vicinity and to the northwestward.

The mean direction of translation was southeast, and all marked trends occurred between the ninetieth and one hundred and second meridians.

The maximum high area of the month was that described as number v, and the cool wave which accompanied it was felt generally throughout the United States.

Two areas of relatively high pressure appeared within the limits of observation on the coasts of the United States and Canada on the morning of October 1st, one central to the southeast of Nova Scotia, extending inland over the Maritime Provinces and adjoining regions, the other off the north Pacific coast, near the shores of Oregon and Washington Territory. The passage of the former across the country in September has been described in the REVIEW for that month (see high area number vii) and its subsequent probable progress noted. It apparently continued its movement to the northeast and passed farther seaward beyond the limits of observation on the night of the 1st, without specially influencing weather conditions on the adjoining coast.

I.—The high area referred to as on the north Pacific coast advanced inland during the night of the 1st, and on the morning of the 2d was central in northeastern Oregon. Moving southeastward, with but little energy, over the Rocky Mountains and northern slope it passed into Nebraska and was central near North Platte on the morning of the 3d. The pressure was then above the normal from the Missouri River westward over the northern and middle slopes and plateaus to the eastern borders of California, Oregon, and Washington Territory, and from about the thirty-fifth parallel northward to British America; elsewhere it was below the normal. The maximum pressure, which mainly covered Wyoming, Nebraska, and Kansas, averaged less than .1 above the normal, but as an area of low pressure, about .8 below the mean, then existed in the vicinity of Mackinaw City, Mich., the gradients were quite marked, and violent gales prevailed on the Lakes. During the succeeding night the area was slightly re-enforced by higher pressure which apparently descended from the vicinity of Manitoba. Afterwards it moved southeastward, and on the night of the 4th was accompanied in its progress by a cold

wave which caused killing local frosts in Wisconsin and eastern Minnesota. It continued to advance in the same general direction, and reached the coasts of the Carolinas on the afternoon of the 6th, where it remained approximately stationary, with slight oscillations in pressure, up to the night of the 8th, when the barometer fell to the normal under the influence of a low area over the Lakes.

II.—During the night of the 6th the pressure over Washington Territory and Oregon was considerably increased, apparently by the approach of a higher area from the north Pacific. The temperature throughout the northern plateau region fell slightly below the normal, and light local frosts occurred in southern Idaho. On the morning of the 7th a decided depression existed over the eastern slope of the Rocky Mountains and the Missouri Valley, influencing weather conditions from the upper lake region, Ohio Valley and Tennessee, and eastern Gulf states westward to the Pacific. The area of comparative high pressure, about .6 above the minimum at the centre of the disturbance, was comprised in the region to the north and west of a line drawn diagonally from the Red River on the British border to the fortieth parallel on the coast of California. A portion of this high area crossed the Rocky Mountains on the night of the 7th and on the morning of the 8th covered the northern slope, but the main area remained on the north Pacific coast. The temperature over Montana fell from 2° to 8° below the normal, and killing local frosts were reported in that territory on the night of the 7th. The detached area moved southeastward into the Missouri Valley, attended by killing frosts in southern Dakota on the night of the 8th; afterwards it remained approximately stationary in that region until it became merged in the higher area advancing from the Pacific.

The main area began to move southeastward from the coasts of Washington Territory and British Columbia on the afternoon of the 9th. Light local rains fell on the mountain slopes during its passage, and light snow in portions of Montana. The advance wave of this high area progressed rapidly, and by the morning of the 10th covered the entire country from the Mississippi, Ohio Valley, and upper lakes westward to the Pacific, except portions of the west Gulf states and the territory bordering Mexico and California. The maximum pressure, about .6 above the normal, which had apparently been receiving successive re-enforcements from the Pacific near northern Washington Territory and British Columbia, still remained central west of the mountains in northern Idaho, near the British border. Local rains were numerous on the eastern slopes of the mountains and in the central valleys, and continued throughout the Lake region and portions of New England, where they had accompanied the progress of the depression above referred to. The maximum pressure subsequently crossed the mountains and on the morning of the 11th, with no marked change in energy, was central over eastern Wyoming and adjacent portions of Dakota and Nebraska, while the advanced waves had moved farther to the eastward and southward. The attendant cool wave, whose temperature ranged in a few instances as low as 13° below the normal, caused many local frosts in the Missouri Valley and adjacent slopes. Rains had generally ceased, but still continued in the Rio Grande Valley, where 5.54 inches had fallen at Brownsville, Tex., during the preceding twenty-four hours, and in portions of New England and the Maritime Provinces. High winds, generally from the northeast, had also prevailed on the coasts of Texas for about sixteen hours and had not yet materially abated. During the next sixteen hours the centre of the high area moved, with diminished energy, into northwestern Texas and Indian Territory, where it assumed the form of a narrow trough, open towards the Mexican frontier and reaching northeastward to the Arkansas River. Gales from the north and east still continued on the Gulf coast from the mouth of the Mississippi westward, and had also set in on the Lakes from the northwest. During the night of the 11th the area remained approximately stationary, but the pressure near the centre decreased about .2, and the attendant cold wave, which

extended northeastward from Louisiana, Texas, and Indian Territory to the borders of the Lakes, caused general frosts, both light and killing, throughout the Ohio Valley and Tennessee, adjacent portions of the Lake region, the southern portions of the upper Mississippi and Missouri valleys, and portions of Mississippi and Arkansas. Northeast gales were reported on the Gulf coast from Galveston, Tex., eastward to Mobile, Ala., and still continued at the former. They had, however, subsided on the Lakes. Within the succeeding eight hours the pressure still further decreased, and at the afternoon report of the 12th the maximum was bounded by an isobar of 30.10, and covered mainly the Rio Grande Valley, southern slope, western Gulf states, southern portions of Missouri and Illinois, and the Ohio Valley and Tennessee as far eastward as the eighty-second meridian.

Its subsequent path cannot be definitely traced, but, apparently, the western portion of the area united with a higher area approaching from the northwest, while that part east of the Mississippi probably moved northeastward off the coast, as traces of its progress seemed apparent during the night of the 12th over northern Alabama, eastern Tennessee, and northeastward towards the coast of New England, where the attendant cool wave caused numerous local frosts. Gales had again set in on the Lakes, north of which another depression was then moving, and the passage to the south of this portion of the high area aided materially, in conjunction with another high pressure farther west, both in their production and continuance.

III.—Morning reports of the 12th indicated the presence of an area of high pressure in the western Saskatchewan valley. A depression then existed to the eastward over the lakes north of Manitoba. Moving southeastward the high area crossed the border and entered the northern slope on the afternoon of the 12th. Rains and southwest gales were reported from the Lake region, north of which the disturbance above referred to was then advancing. It continued its progress in the same direction, with but slight modifications in energy. After reaching the Mississippi River near the northern boundary of Iowa on the night of the 13th, it trended more to the eastward, and the gales and rains ceased as it approached the Lakes and as the disturbance passed to the eastward down the Saint Lawrence Valley. The temperature fell rapidly as it progressed across the Lake region, and on the night of the 14th numerous killing frosts were reported from Ohio, Pennsylvania, and western New York, where the temperature fell in many instances to 16° below the normal. Its path from the morning of the 15th, when it was central near the southeastern coast of Lake Erie, was more to the southward. It reached the New Jersey coast within the next sixteen hours, and during the succeeding night caused many local frosts from North Carolina northward over the coast region to New England. During the 16th it passed off the coast into the north Atlantic.

IV.—From the 14th to the 19th, inclusive, the pressure on the north Pacific coast was subject to marked fluctuations. Areas of comparative high pressure would frequently appear which would develop sufficient energy to force advance waves inland that would frequently cross to the eastern slope of the mountains and cause local frosts and rains, but no other marked weather modifications. At times the entire area would apparently advance in the same manner and eventually disappear before reaching the Mississippi, without showing a well-defined extended track or having any special apparent influence on the weather conditions generally, the pressure meanwhile on the coast having been materially re-enforced so as to form a new high area. On the night of the 19th, however, a comparatively well-defined area of high pressure, about 3 above the normal, advanced inland to eastern Oregon. Moving slowly to the southeast, it crossed the mountains, and on the morning of the 21st it covered the greater portion of the country from the mountains eastward to the Mississippi, except Montana, where the pressure had begun to decline in advance of a disturbance approaching from the northwest. Depressions of temperature of from 5° to 19°

occurred throughout the area, and killing frosts were reported in Kansas. High winds had attended the progress of a depression over the Lakes since the 19th, and still continued, apparently augmented by the advance of this high area. During the next sixteen hours it moved southward, with diminished energy, to the west Gulf coast in advance of a low area following from the Northwest. Trending afterwards to the northeast, it passed during the night of the 21st to the east of the Mississippi, covering the country from the Ohio River southward to the Gulf and eastward to the south Atlantic states and the borders of the Virginias, causing numerous local frosts therein and in northern Ohio and southeastern Wisconsin. Gales had abated on the upper lakes, but still continued at eastern ports on Lakes Erie and Ontario. It continued its progress towards the middle Atlantic coast, the gales abating on the lower lakes as it advanced, and during the 23d passed into the Atlantic, apparently still continuing its direction towards the northeast. Killing local frosts were reported in the coast regions of the middle Atlantic states and New England on the night of the 22d, where the temperature fell from 10° to 16° below the normal.

V.—Afternoon reports of the 22d showed a marked increase in pressure in the western Saskatchewan valley near the mountains. Snow was then falling in that region and along the valley to the eastward north of Montana, at numerous points in that territory, and in Dakota and the northern border of Nebraska, also at several stations in the upper Mississippi valley. Local rains were also reported from stations both in the Missouri and Mississippi valleys. A storm of considerable energy was then central over the middle slope. During the next sixteen hours the pressure continued to increase, and on the morning of the 23d the high area, bounded by an isobar of 30.6, .68 above the normal, was still central in the same region. Meanwhile the depression had progressed into the Mississippi Valley, where the minimum pressure was slightly over .5 below the normal. The gradients were therefore marked. Heavy rains prevailed near the centre of the disturbance and light local snows continued to the northwestward towards the region of high pressure. The cold wave accompanying the high area extended southward to Texas and Arizona and westward from the low area to the Pacific, except over portions of California, where the variations from the normal were slight. The temperature at Calgary, N. W. T., apparently near the centre of the high area, was reported at 6°, 33° below the normal, and killing frosts occurred both in Idaho and Oregon. During the next eight hours the area began to move to the southeast, and heavy gales set in on the Lakes. Crossing the northern slope, it moved thence eastward towards the southwestern coast of Lake Michigan, near which it was central on the afternoon of the 25th, without any marked change in energy. The high winds subsided over the Lakes as it progressed, and, as the low area travelled in advance, passed rapidly to the northeast. Its subsequent course was to the northeast over Michigan into Quebec, thence through southern Ontario, the northern portion of Maine, and New Brunswick to the Gulf of Saint Lawrence, which it reached on the night of the 26th. At this time, though the western limit of the nucleus of maximum pressure, represented by the isobar of 30.6, was adjacent to the western coast of the Gulf of Saint Lawrence, and the eastern boundary, represented by the same isobar, was probably not far seaward, yet the waves of high pressure in rear covered a vast extent of territory and extended in irregular loops southwestward to the middle and southern slopes and thence northwestward to the Pacific coast. As the main area moved farther eastward off the coast detached areas of comparative high pressure formed apparently in the broken waves in rear and gradually disappeared. The largest of these subordinate high areas, enclosed by an isobar of 30.30, extended, at the last report on the 27th, in a belt about three hundred and fifty miles wide from the southern slope northwestward to the eastern border of the north Pacific region, with the maximum pressure central in western Colorado. During the 28th the centre of this area moved north-

westward into Idaho and western Washington Territory, with slightly increased energy, and remained nearly stationary in that vicinity until the 29th, when it apparently became merged in a higher area moving southward from Manitoba.

The heavy gales produced on the Lakes by the passage of this high area in rear of a marked depression caused great loss of life and property, especially on Lake Michigan, and the cool wave which accompanied it was felt generally throughout the country, and did considerable injury.

VI.—This high area apparently approached northeastern Dakota and the adjoining border of Minnesota on the afternoon of the 28th from the British Possessions to the northeast of Manitoba. The general direction of the path of maximum pressure was to the southward down the Red River and Missouri valleys, and, early in its progress, its waves extended westward over the mountains so as to unite with the high area central in Idaho. As it advanced southward high winds arose on the Lakes, over which a depression had recently passed. Local rains and snows were also frequent over that region and extended northeastward as the depression moved seaward, and as the advance waves of the high area progressed eastward. At the last report on the 29th the centre of pressure, bounded by the isobar of 30.5, extended in the form of an ellipse from southwestern Colorado to western Wisconsin, the longer axis pointing to the northeast. Low areas at this time existed near Manitoba and on the coast of the Carolinas. A line drawn diagonally from Fort Garry, Manitoba, to Yuma, Ariz., approximately represented the isotherms of normal temperatures, those to the westward being above, and those to the eastward below the mean; depressions of 25° existed, in a few instances, near the centre of the high area, elsewhere they were not so marked. During the succeeding night the high area moved farther to the southward and slightly to the westward, causing local frosts in the lower Mississippi valley from Alabama northward, and in the western Ohio valley. The gales subsided on the Lakes and the precipitation generally ceased. During the 30th the pressure throughout the area decreased materially, and at the last report on that date the maximum, bounded by an isobar of 30.3, extended in a crude semi-ellipse from the western Gulf states and Rio Grande Valley northwestward into Utah and Wyoming. On the night of the 30th the cool wave extended eastward over the eastern Gulf and western portions of the south Atlantic states, causing numerous local frosts, both light and killing. The pressure throughout the area still further declined during the 31st, and at the last report of the month the isobar of 30.2, enclosing the maximum pressure, extended in a trough from the coasts of the western Gulf states and the Rio Grande Valley northwestward into Idaho and western Montana, apparently not specially affecting weather conditions in the vicinity.

Another area of comparatively high pressure was at the close of the month apparently central in the British Possessions to the north of Lake Superior.

AREAS OF LOW PRESSURE.

During the month eleven low areas, whose paths have been traced on chart i, have appeared within the range of observation, or sufficiently near to permit their approximate location. Eight of these were first observed in the Saskatchewan Valley, whence six passed to the Atlantic through, or adjacent to, the Gulf of Saint Lawrence, and the other two, it is believed, pursued approximately a similar course, although they moved into the British Possessions beyond the field of direct observation, one near the eighty-second, the other near the ninety-seventh, meridian. One low area apparently developed in the northern plateau, moved southeastward into Wyoming, where it divided, one subordinate depression passing to the Atlantic through the Gulf of Saint Lawrence, the other through Texas into Mexico. Two others, of cyclonic energy, moved from the Gulf of Mexico in a general northeastward direction, one of which united in Maine with a depression from the Saskatchewan Valley, passed northward and subsequently north-

eastward with it to the Gulf of Saint Lawrence; the other crossed the peninsula of Florida, and, moving approximately parallel with the coast, was central at the close of the month off the middle Atlantic states.

The mean direction of translation was slightly to the south of east, and the development or first location of the respective centres, and also their subsequent paths, farther to the north than usual.

The month in general has been particularly unfavorable to lake navigation. The paths of nine low areas (including the two above noted as having passed into the British Possessions) having either crossed or been sufficiently near the Lake region to have affected more or less seriously atmospheric conditions therein and endangered or caused the loss of many valuable lives and much property. Storms numbers i and viii were notably severe (see descriptions and extracts).

The following table furnishes interesting information relative to these areas of low pressure:

Number of area.	First observed.			Last observed.			Average progress per hour.
	Date and time.	Lat. N.	Long. W.	Date and time.	Lat. N.	Long. W.	
I.....	1, 7 a. m.	52 00	107 00	6, 10 p. m.	46 00	58 00	19.5
II.....	4, 3 p. m.	51 00	110 00	6, 3 p. m.	47 30	83 00	34.2
III.....	5, 10 p. m.	44 00	115 00	12, 7 a. m.	47 00	58 00	25.8
III a.....	6, 10 p. m.	39 00	107 00	9, 3 p. m.	26 30	100 30	23.4
IV.....	11, 3 p. m.	52 30	109 00	15, 7 a. m.	48 00	58 00	27.6
V.....	14, 7 a. m.	51 30	115 00	18, 3 p. m.	49 00	69 00	28.8
VI.....	17, 7 a. m.	23 00	96 00	21, 10 p. m.	49 00	68 00	23.5
VII.....	18, 7 a. m.	52 00	114 30	21, 3 p. m.	45 30	70 00	26.8
VIII.....	21, 7 a. m.	51 00	115 00	24, 10 p. m.	48 45	61 30	38.9
IX.....	27, 3 p. m.	51 30	114 30	29, 10 p. m.	47 00	61 30	48.2
X.....	26, 7 a. m.	26 00	85 00	31, 10 p. m.	38 00	73 30	18.2
XI.....	29, 3 p. m.	53 00	112 00	30, 10 p. m.	52 00	97 00	19.7

Average rate of progress, 27.9 miles per hour.

The low area referred to in last REVIEW as central at the close of September near Grand Traverse Bay in northern Michigan was, on the morning of the 1st, approximately in the same position. Moving subsequently northeastwards into the province of Ontario, it crossed north of the Lakes towards the Saint Lawrence Valley, down which it apparently passed into the Atlantic in advance of a lower area closely following. Frequent rains fell to the south of its path over the Lakes, northern New England, the Maritime Provinces, and in the valley during its progress. The high area which on the night of the 1st was adjacent to the coast of the Maritime Provinces, impeded somewhat its movement seaward. Gales on the Lakes did not immediately succeed its translation, owing to the rapid advance of a greater depression in rear, but those which set in after the passage of the latter were probably materially augmented by the proximity of this area to the eastward.

I.—Morning reports of the 1st indicated the presence in the Saskatchewan Valley, adjacent to the junction of the two main branches of the river, of a well-defined low area which had apparently during the preceding night moved eastward from the mountain slope. Conditions in advance were favorable for its rapid translation, as a depression existed over the Lakes and the pressure towards the Atlantic coast was below the normal, except in portions of New England and the Maritime Provinces, where it was rapidly declining. The low area moved eastward during the 1st towards the lakes north of Manitoba, but during the succeeding night trended more to the south, and on the morning of the 2d was central in Minnesota. Higher temperatures and local rains attended its progress. Its general subsequent direction was eastward into the province of Ontario until it reached the region to the north of Parry Sound, where its progress for sixteen hours, from the afternoon of the 3d to the morning of the 4th, was materially retarded. Changing its direction subsequently to the south-east, and moving more rapidly, it crossed the Saint Lawrence River near the eastern shore of Lake Ontario on the night of the 4th and, passing through New England, was central off the coast of New Hampshire at the last report on the night of the

5th. Afterwards, apparently, it moved off to the northeast along the coasts of the Maritime Provinces. Local rains attended its progress across the Lakes and on the coasts, and heavy gales on the afternoon of the 2d, and on the 3d and 4th, prevailed over the Lake region and caused many disasters to shipping and much loss of property. On the morning of the 3d, when the depression was central north of the Straits of Mackinaw, the pressure had reached the minimum observed during translation. A barometer reading of 29.26, .8 below the normal, was then reported from the station at Mackinaw City, Mich., and as an area of comparative high, nearly .1 of an inch above the normal, then existed to the southwestward, the gradients at that time and during the day were quite marked and the gales more than ordinarily severe.

The following extracts will show the severity of this storm:

DETROIT, MICH., October 4.—A special to the "News" from Marquette, Mich., says: The heaviest gale ever recorded at the Marquette signal station is still raging. It began Sunday noon, with a thirty mile wind from the southwest. It shifted to the west, and since midnight Sunday has averaged a velocity of thirty-eight miles an hour on the open lake. Four times yesterday the wind reached a velocity of forty-two miles at the station, or fifty on the lake. A terrible sea is running, and the wind at 1 p. m. was blowing thirty-four miles, with no sign of a break in the storm. The weather is thick.

On the 3d the wind increased in violence, blowing a gale from the northwest. Estimated velocity between forty and fifty miles per hour. The wind abated somewhat on the 4th, but continued to blow hard until sundown, when it died down.—*Mr. Geo. L. Collie, voluntary observer, Delavan, Wis.*

The westerly gale hauled to the northwest and moderated some at Chicago, but the wind is still blowing fresh from that quarter. Early in the morning the wind was raging with unabated violence in the vicinity of the straits, where the velocity was forty-eight miles an hour. The storm was central over Georgian Bay, and heavy winds prevailed throughout the lower lake region. Very few vessels reached here during the day, but all that did bore marks of rough usage outside. From the reports of vessel captains the storm was far more terrible on Lake Michigan than those who were safely ashore can realize. The steamer "Jewett," which was never known to turn tail in a gale of wind, bucked against the wind and sea at the foot of the Lakes for six hours without making any perceptible headway.—*Chicago Tribune, October 5th.*

The observer at Mackinaw City, Mich., reports that the propeller "California," bound from Chicago to Montreal, foundered off the island of Saint Helena at 1.30 a. m. on October 4th. She was laden with 700 barrels of pork and 20,000 bushels of corn, and went down in about fifty feet of water. Nine lives were lost; the vessel went to pieces and will probably prove a total loss.

At midnight the tug "Green" left for the lake and this morning picked up the schooner "Canton," ore-laden, from Escanaba, and though only drawing twelve feet of water she dragged along the bottom, and few tugs other than the "Green" could have brought her in. Captain Berlin, of the "Canton," reports a fearful experience on Lake Huron. He came down the lake in a tow of six vessels. Sunday night tow broke loose from the tug and went adrift. For twenty-four hours immense seas broke over the staunch little vessel but she weathered it bravely and reached the rivers in good time and safe.—*Toledo Bee, October 4th.*

Yesterday afternoon Messrs. Sullivan and Hubbard, of this city, received a dispatch stating that the schooner "Pulaski," owned by them, while on the way from Sandusky to Manitowoc, coal-laden, had gone ashore during the storm and was a total loss. Capt. P. J. La Vow, in a dispatch, says the schooner had been run close to shore and anchored, but the heavy wind dragged her ashore, where the heavy seas soon tore her to pieces.—*Toledo Bee, October 5th.*

CLEVELAND, OHIO, October 4th.—Sunday night and yesterday violent westerly gales succeeded one another in such quick succession as to be almost a continual hurricane. Trees, signs, chimneys, and roofs suffered, but no serious damage was done here.—*Portland (Me.) Daily Press.*

ERIE, PA., October 5th.—A two-masted schooner went ashore at Ripley shortly before dark last evening. The gale raged furiously all the afternoon. The last seen of the craft there were six men in the rigging. The United States revenue cutter "Perry" went to the rescue, but, on account of the darkness, it is feared that the men were not saved. The name of the schooner is not known. Several tugs which ventured to go to the relief of the vessel were obliged to put back.—*Toledo Bee.*

A gale began at 5.10 p. m. on the 2d and ended at 5.45 p. m. on the following day; maximum velocity of the wind, forty-eight miles per hour, from the west, was recorded at 10.52 p. m. on the 2d. A similar velocity was also recorded from the northwest at 12.42 p. m. on the 3d.—*Observer, Milwaukee, Wis.*

A heavy gale prevailed during the day of the 4th; schooners "City of Green Bay" and "Havannah," from this port, were lost in the gale, with nine seamen. The vessels and cargo are valued at \$30,000. The storm is reported to have been the most violent of the season.—*Observer, Escanaba, Mich.*

A gale began about midnight on the 2-3d, and continued high all day, reaching its maximum velocity, thirty-five miles per hour, at 12.10 p. m. Some trees were blown down, and the high smoke-stack of State Printing House was blown over.—*Observer, Lansing, Mich.*

A severe gale set in from the southwest at 7.27 a. m. on the 3d, and con-

tinued throughout the day. The lake at this port was very rough, submerging both breakwaters, and at times the water was forced above both light-houses; the breakwaters sustained heavy injuries. Buffalo River rose seven feet during the storm, flooding a number of houses, and on the island and along the water front numerous families were obliged to vacate their homes. The New York Central Railroad was compelled to keep trucks on the tracks in order to protect them from destruction. Barge "C. L. Hutchinson" ran ashore about ten miles from this city with a cargo of 35,000 feet of lumber; the vessel became a total wreck, but the crew were saved. Considerable damage was done in this city; trees, signs, fences, cornices, chimneys, and roofs being carried away by the wind. Sea captains state that this was the most severe and destructive storm that has ever visited the Lake region so early in the season.—*Observer, Buffalo, N. Y.*

II.—This disturbance was first definitely located on the morning of the 4th, north of Montana, near the south branch of the Saskatchewan River. During the next eight hours the pressure in that vicinity declined rapidly, probably owing to the approach of the area from the northwest beyond the limits of observation. Subsequently, however, during the day the centre of the depression apparently moved to the eastward, with decreased energy. As it approached the lakes north of Manitoba it trended southeastward in the form of a trough and covered western Minnesota. Moving farther southward it was central over Iowa and southern Minnesota at the last report on the 5th, but during the succeeding night moved northeastward towards the eastern portion of Lake Superior. Its subsequent course cannot be definitely traced, as it passed into Canada beyond the regions of observation. Its approximate course was apparently, however, northeastward towards the northern coast of the Gulf of Saint Lawrence, as a low area (most probably this one) was observed in that vicinity on the 7th, 8th, and 9th, passing seaward; local rains were also prevalent throughout the Lake region and northeastward towards the Gulf on the 5th and 6th, and in portions of the Maritime Provinces on the 7th, apparently attendant on the passage of a depression to the northward. Directions of wind and records of atmospheric conditions in these regions also pointed to the same conclusion.

III.—Night reports of the 5th seemed to indicate the development of a disturbance near Boise City, Idaho. The pressure at that time over the entire country was below the normal, ranging from about .06 below the mean to .46. Local rains were falling in northern California and the coast regions northward. Eight hours afterwards a well-defined depression existed in the form of a narrow trough, extending from about the middle of Utah northward into northern Montana, averaging about .6 below the normal. During the rest of the day the centre of the depression moved southeastward, with increased energy and contracted limits, into western Colorado, where, on the night of the 6th, it was located as a small oval, pointing approximately east and west. Rains had generally ceased, but had extended inwards from the coasts over the mountains and slopes to the north of the disturbance, and also into portions of the Missouri and Mississippi valleys. A high southeast wind was reported at Corpus Christi, Tex., and a maximum velocity of thirty miles from the same direction during the previous eight hours. During the succeeding night the depression seemed to divide, two separate nuclei being apparent on the morning of the 7th, one central on the borders of Colorado and Kansas, with a pressure about .6 below the normal; the other near Prescott, Arizona, .76 below the normal. During the day the northern centre of depression moved northeastward, with diminished energy, to the neighborhood of Saint Paul, Minn., and the southern, eastward into New Mexico. Rains generally prevailed from the Mississippi westward to the mountains, and had fallen at many lake ports. Snows also were reported at a few stations in the northern slope. Gradients were close near both depressions. High southeast winds continued at Corpus Christi, Tex., and winds were beginning to freshen on the upper lakes and had in a few instances already reached velocities dangerous to navigation.

During the 8th the northern depression moved southward from near Saint Paul, Minn., through Iowa into northwestern Missouri, and afterwards changing direction to the northeast

during the succeeding night crossed Wisconsin and reached the northern coast of Lake Michigan on the morning of the 9th. Copious rains attended its path both in the valley and near the upper lakes. Its general course subsequently was eastward, north of the Lakes, towards the Saint Lawrence and down the adjoining valley to the sea. Abundant rains fell along its path and to the southward, and high local winds were reported from lake stations on the 10th and 11th. As it approached the Gulf of Saint Lawrence its energy seemed to increase, and it passed into the Atlantic on the 12th, apparently as a well-developed low area. The southern depression, which at the last report on the night of the 7th was central in New Mexico, moved eastward during the next sixteen hours into northwestern Texas, thence trending southward it crossed the Rio Grande on the morning of the 9th, and passed southward into Mexico, being approximately central to the west of Rio Grande City, Tex., at the afternoon report of that date. It was accompanied by local rains in the vicinity of its path, and by gales on the Texas coast near Corpus Christi, which subsided during the 8th.

The future course of this disturbance is a question for consideration. A low area appeared on the morning of the 10th to be approximately central near the Mexican coast and subsequently seemed to move eastward into the Gulf near the twenty-fifth parallel. This may possibly have been the same disturbance, which perhaps trended to the east in Mexico and passed into the Gulf.

IV.—This low area was first observed near the north branch of the Saskatchewan River west of the one hundredth and seventh meridian on the afternoon of the 11th. It moved southeastward with comparatively feeble energy, reaching the lakes north of Fort Garry, Manitoba, on the morning of the 12th. Afterwards it crossed the province of Ontario north of the Lakes, influenced by the higher pressure to its south, entered the Saint Lawrence Valley and passed into the Gulf across the northern border of New Brunswick on the morning of the 14th. Twenty-four hours afterwards it was apparently central on the southern coast of Newfoundland, passing seaward. High winds and dangerous local gales occurred in the Lake region on the 11th, 12th, and 13th, and also on the coasts of New England on the last date, during its progress to the north and east of these regions. Light rains fell along its path and in the vicinity southward. The depression had apparently attained its maximum energy on the afternoon of the 12th, when it was central north of Lake Superior, with a pressure about .6 below the normal. Within the succeeding eight hours, however, its energy declined materially and the pressure increased nearly .2. As it approached the Gulf there was a further decline in energy, and when it left the coast it was apparently but a slight depression of comparatively little magnitude and feeble force.

V.—Morning reports of the 14th indicated the presence of another depression in the western Saskatchewan Valley adjacent to the mountain slope. During the next sixteen hours it moved in a direction slightly south of east and reached the vicinity of the one hundred and fourth meridian. Thence it trended more to the southward, crossed Dakota, and passed into western Nebraska, where it was central on the afternoon of the 15th, resembling in general outline an ellipse with the major axis pointing northeast. Light local rains had fallen on the mountains to the westward and in the Missouri and Mississippi valleys. High winds were reported both on Lake Superior and in northern Michigan. An area of comparatively high pressure was then central southeast of Lake Ontario, influencing atmospheric conditions westward towards the depression, and probably materially modifying its path. During the next eight hours the centre of the depression moved southeastward through Nebraska to the vicinity of the Platte River. Thence it moved northeastward into southern Minnesota, with diminished energy. Trending afterwards to the southeast it crossed the Mississippi north of Dubuque, Iowa, on the afternoon of the 16th and passed northeastward into the province of Ontario

across the intervening states and lakes. Moving eastward afterwards to the valley of the Saint Lawrence it passed down to the vicinity of Father Point on the afternoon of the 18th, and, changing its direction more to the northward, advanced into the province of Quebec beyond the limits of observation. Local rains, generally light, fell in the Lake region during its progress there, and while to the northward, and also in the valley portions of New England and the Maritime Provinces. Local gales of moderate force, mainly from the southwest quadrant, were reported at a few lake ports on the 15th, 16th, and 17th.

This depression was at its maximum when in the valley north of Montana, where the pressure was a little over .6 below the normal. Its energy during translation was at no time specially marked, and materially decreased when it passed to the east of the Mississippi.

VI.—On the morning of the 17th the disturbance which had apparently for several days been indicated to the south of the Gulf coast of the United States seemed to be approximately located off the coast of Mexico, south of the mouth of the Rio Grande. Frequent rains had fallen during the preceding twenty-four hours at stations on the coasts of Florida, and on the Gulf westward, and still continued. The pressure at Brownsville, Tex., the station nearest the centre of disturbance, was about .2 below the normal, and still decreasing. An area of comparatively high pressure was in the northern plateau region, and another, which had been for about thirty-two hours approximately central on the New England and middle Atlantic coasts, and which had probably materially modified the movement of this low area, had recently moved seaward. Moving approximately northeastward towards the mouth of the Mississippi the disturbance approached the Louisiana coast with cyclonic energy and reached the vicinity of New Orleans, La., on the morning of the 19th. A barometer reading of 29.22, .82 below the normal, was reported from that station on that morning, which represented a fall of .52 during the preceding eight hours. Gales of hurricane force from northeast to northwest had prevailed on the west Gulf coast on the 18th, but had subsided, except in the immediate vicinity of the depression, where gradients had become quite marked, averaging about one-tenth in thirty miles between New Orleans, La., and Mobile, Ala. Passing to the southeast of New Orleans the centre of the storm moved northeastward into Alabama on the 19th, accompanied by heavy gales and rains.

Storm signals had been ordered well in advance, and the public had been fully advised both of the approach of the storm and its probable direction. Much damage, however, was done to shipping in the Gulf, especially in the vicinity of New Orleans, La., and Pensacola, Fla., where the gale was unusually severe. On the 19th a maximum velocity of forty miles was reported at Galveston, Tex.; forty-two miles at New Orleans, La. (between 8 and 9 a. m.); forty-eight miles at Pensacola, Fla.; and fifty miles at Mobile, Ala. Minor damages, besides, occurred in that vicinity, such as the prostration of telegraph wires, trees, fences, etc. During the afternoon and night of the 19th the central pressure materially increased and the energy declined as the low area progressed northeastwards towards the coast of North Carolina, which it reached on the evening of the 20th. Trending afterwards more to the north, it passed, with increased energy, into the Atlantic, and moving adjacent to the coast crossed southeastern Massachusetts and entered New Brunswick, where it was joined on the evening of the 21st by another low area, number vii, approaching from the west. The combined area advanced thence northward with marked energy, crossed the Saint Lawrence near Father Point and apparently passed off into the British Possessions to the northeastward.

The gales subsided on the Gulf coasts during the night of the 19th, but set in during the succeeding day on the coast of the south Atlantic states, and subsequently northward as the storm advanced. Prominent eastern seaports had been fully apprised by the display of signals and bulletins, and also

through the press, of the advance and probable severity of the storm, yet as many vessel owners choose to take the risk, and numerous vessels were en route on their respective voyages, much damage and many minor disasters resulted, as the gales, especially on the middle Atlantic and New England coasts, and also in the Gulf of Saint Lawrence, were very severe. Maxima velocities ranged on the Atlantic coasts from forty to fifty miles. General rains fell along and adjacent to the path of the depression.

The following extracts from the reports of observers, and items from the public press, refer to this storm:

New Orleans, La.: heavy rain began at 12.30 and ended at 10 a. m. on the 19th, it recommenced at 1.20 and ended at 2.30 p. m.; total amount of rainfall during the storm, 2.19 inches; high wind prevailed during the storm, reaching a maximum velocity of forty-two miles per hour from the north at 8.35 and 8.45 a. m.; the wind storm ended at 3.17 p. m.

NEW ORLEANS, LA., October 19.—The heaviest rain of the year fell last night, and the barometer reached a lower point than is on record since the establishment of the signal service station here. It rained nearly all day and all night, the fall being registered at two inches. The rear of the town was flooded. The fires at the draining canal were put out by the flood. The draining canals were bank full, and the level for some hours was several feet higher in the rear than the front of the town. Thousands of acres of cane, ready for cutting and grinding, were beaten to the ground by the mud and rain, and cotton not yet picked was trodden down in the mud. In the city proper the frame-work of the new Catholic church of Our Lady of Good Council, in the sixth district, was blown down, and the Rev. Father Lambert caught in the timbers and painfully bruised. The floating grain elevator, "Jennie Armstrong," had her top-works blown away, involving a loss of \$10,000. The roof of the cotton mill of Lehman & Abrams, and the machinery, are drenched with the flood. The Louisville and Nashville Railroad line near Lake Catharine again suffered, some two or three hundred feet of track being washed out. Electric light wires were thrown from their fastenings and five buildings in different parts of the city were set on fire thereby. Hundreds of trees throughout the city were uprooted and fences blown down. No lives were lost, but there were many narrow escapes. The wind reached a velocity of forty-eight miles an hour.—*Chicago Tribune*, October 20th.

Pensacola, Fla.: a heavy gale prevailed during the 19th, maximum velocity forty-eight miles per hour from the southwest; the high wind caused some damage to telegraph lines, and all telegraphic communication was cut off. Lumber merchants who did not take precautionary steps to save their lumber lying in the bay lost it all.

New York was caught right between the teeth of two cyclones yesterday. It got badly bitten. One cyclone came up from the balmy South, as was predicted by the "Herald" yesterday. It raised havoc all day yesterday and did lots of damage and created a good deal more fear. The other cyclone came from the Northwest, where they always keep them on tap, and enhanced the racket.

On Thursday all the steamship officers were warned not to send out southward bound vessels. Some sailed, however, despite the warning. The "Newport," of the Pacific Mail Steamship Line, was one of the vessels that went out. Her captain thought that he could avoid the storm by hugging the coast. The vessel was supposed to be about off Cape Hatteras last night, and it was feared that she has had a pretty rough time of it. The "City of Pueblo," for Valparaiso, was to have sailed yesterday, but her captain, being impressed with the value of the warning, delayed the time of her departure until this morning. The "City of Atlanta" went out, but her captain thought he could dodge the storm. The skippers of a score of smaller craft that went out were of the same opinion, and believed that the storm would pass out to sea before they could encounter it. It is feared that to-day will tell a sad tale of wreck all along the coast, and with it the contingency of a loss of life.

At 10 p. m. on Thursday the steamer "Charles F. Mayer," a collier, bound from Boston to Baltimore, went ashore on the Jersey coast, near Chadwick. The point where she stranded was about half a mile south of Life Saving station No. 12. Keeper Petit, in command of the station, and his men took the crew of seventeen ashore by means of the breeches buoy. Surfman Benjamin Truax discovered the stranded vessel in the midst of a terrible storm. Signal lights were at once burned and the mortar hauled out on a cart to the beach. A line was fired and landed over the ship at the first attempt. The arrangements were quickly made and the men hauled ashore through the seething and booming surf. The vessel is high and dry and can easily be hauled off as soon as the storm subsides.—*New York Herald*, October 22d.

CHATHAM, MASS., October 21st.—The steamer "Alleghany" struck something off West Chop and ran ashore to keep from sinking. The cargo is in a dangerous condition. Eight passengers are on board and are all well; they will be sent ashore at the first chance. The ship is damaged forward.

NEW YORK, October 21st.—The cyclone that has played havoc in the South was off Virginia at 7 o'clock this morning. The vessels which left this port for the South yesterday are very likely to run into the storm. They were the "Newport," for Aspinwall, "City of Atlanta," for Savannah, "New York," for Galveston, "City of Savannah" and "Richmond," for Newport. A high wind prevails this afternoon.—*The Palladium*, Oswego, N. Y., October 21st.

Block Island, R. I.: light and heavy rains prevailed during the forenoon up

to 11.20 a. m. on the 21st. High southeasterly winds began during early a. m. and, shifting to north at 10.45 a. m., attained a maximum velocity of forty miles per hour from the last-mentioned direction. Several disasters occurred during the gale. Schooner "Rose Bros." broke from her moorings at 4 a. m., but was saved by the life-saving boats. Schooner "Mystery" parted her cables at about 6 a. m. and was driven against the breakwater and damaged.

VII.—This disturbance was first definitely located near the sources of the Saskatchewan River on the mountain slope north of western Montana on the morning of the 18th. Gradients of pressure southward were marked, as a comparatively high area then existed from the Missouri River westward to the middle Pacific coast. Moving with high energy the centre of the depression passed to the southeast, advanced across the northern portion of Lake Superior, through southeastern Ontario and the adjoining border of Quebec, crossed the Saint Lawrence northeast of Montreal, passed through northern Maine into New Brunswick on the 21st, and united with low area number vi advancing from the southward. The subsequent course of the combined area has been described in connection with the preceding low area. Local rains fell along the path of the depression and to the southward, and heavy gales, mainly from southwestern and northwestern quadrants, occurred in the Lake region during its passage to the northward and eastward. The central pressure, which on the night of 18th was apparently at its minimum, when the depression was north of eastern Montana, was slightly over .8 below the normal, but as it passed to the east of the lakes north of Manitoba its energy declined somewhat, though throughout its entire path it was comparatively high.

Observers report as follows, relative to this disturbance:

Fort Custer, Mont.: light rain fell during early morning on the 19th, and high winds prevailed from 12.42 to 2.42 a. m., and from 10.21 a. m. until 6 p. m.; a maximum velocity of fifty miles per hour from the north was recorded at 1.45 a. m. No serious damage has been reported.

Marquette, Mich.: a heavy wind storm commenced at 10.20 a. m. on the 19th; registering a maximum velocity of thirty-six miles per hour from the southwest at 11.59 a. m.; a similar velocity was recorded from the south at 3.27 and at 4.41 p. m.; the gale ended at 5.28 p. m.

Columbus, Ohio: a westerly gale began at 1.30 a. m. on the 21st and lasted fifteen minutes, the wind attaining a maximum velocity of thirty miles per hour at 1.40 a. m. Another gale began at 9.25 a. m. and ended at 4.05 p. m., reaching a maximum velocity of forty-two miles per hour at noon. The damage done by the high wind was slight.

Erie, Pa.: high westerly winds prevailed all day on the 21st; maximum velocity, forty miles per hour from the northwest at 10.07 p. m. A high northwesterly gale prevailed all day of the 22d; maximum velocity, thirty-six miles.

Buffalo, N. Y.: a gale set in from the west at 3.18 p. m. on the 21st and continued until after midnight. A maximum velocity of thirty-eight miles per hour from the west was recorded at 10.25 p. m.

Oswego, N. Y.: a storm began 7.20 p. m. on the 21st and increased in force until early morning of the 22d, when a velocity of thirty-six miles per hour was recorded several times from 3.25 to 5.50 a. m.; a maximum velocity of forty-eight miles per hour was also recorded within the above-mentioned time. Rain and sleet fell at intervals during the 22d. The storm ended at 5.30 p. m. on that date. The water in Lake Huron was very rough during the storm. The schooner "Delaware" had some of her sails carried away.

The presence of a depression was indicated off the Carolina coasts on the afternoon and night of the 18th. Heavy local rains then prevailed there and in southern Virginia, and subsequently extended northeastward as the disturbance progressed apparently in that direction. On the afternoon of the 19th it was approximately off the coast of southern New England, causing high local winds on the southern shore of Massachusetts. For further information relative to this storm see description of depression number 11 under "North Atlantic storms of the month" in this REVIEW.

VIII.—Morning reports of the 21st showed the presence of another low area in the western Saskatchewan valley, slightly to the southwest of the location where the preceding area was first observed. Moving southeastward, with increasing energy, into northwestern Indian Territory, which it reached on the night of the 22d, it changed its direction to the northeast and, progressing rapidly, crossed Lake Michigan on the afternoon of the 23d, reached Georgian Bay within the succeeding eight hours, and passed speedily down the Saint Lawrence Valley to the Gulf, where it was central to the east of Anticosti on the night of the 24th, and thence passed seaward, apparently

over Newfoundland. This depression moved with marked rapidity, its average velocity over the path of about 3,420 miles being 38.9 miles per hour. The rapid translation was probably materially due to the swift approach of a marked high area in its rear, and the comparatively low pressure over the Lakes and northeastward in its advance. Its energy was at the maximum on the afternoon of the 23d, when in northern Michigan, between the Lakes; the central pressure at the time being of contracted area, and about .7 below the normal. Precipitations were general along, and near, its path. Rains were most frequent, but light snows were also numerous, caused by the rapid advance of the cold wave accompanying the high area in rear. Violent local gales, mainly from sw. and nw. quadrants, occurred on the Lakes on the 23d and 24th, and were accompanied by rain and snow-squalls, which still further tended to endanger life and property. Shipping generally seems to have suffered much damage, and considerable loss of life is also reported.

The storm seems to have been unusually disastrous, especially in the Lake region. Heavy gales also prevailed on the New England coasts on the 24th, and in the Gulf of Saint Lawrence and adjacent regions on the 25th and 26th.

The following extracts, from the reports of observers, and from other sources, will show the extent and marked severity of this storm:

Saint Louis, Mo.: a severe gale, accompanied by light rain, occurred from 10.40 to 11 a. m. on the 23d, the maximum velocity of the wind, sixty miles per hour, was reached at 9.46 a. m.

Cairo, Ill.: the high wind on the 22d, with maximum velocity twenty-nine miles from the south, troubled all the Western Union wires between this city and Saint Louis, Mo., and it was with great difficulty that any message could be transmitted between these points. Steamers on the Mississippi River experienced much difficulty in making their landings, the river being very rough. High winds occurred also on the 23d and 24th; maximum velocities of thirty and thirty-two miles per hour from the north were recorded on these dates, respectively; high northerly winds prevailed during the morning of the 24th, with a maximum velocity of forty miles per hour from the north; steamer "Belle Memphis" was driven ashore and delayed ten hours.

Chicago, Ill.: brisk and high east to west winds and cloudy weather prevailed during the 23d, with light rain in the forenoon. The gale caused much damage to trees, signs, and in some cases to buildings.

Milwaukee, Wis.: a storm began to blow from the southeast at 11.05 p. m. on the 22d and ended at 8.15 a. m. the following day; maximum velocity of the wind, thirty-five miles per hour, from the southeast, occurred at 4.12 a. m. on the 23d. This storm was the most severe of the season at this port, and the first one with an on-shore wind. A large number of vessels sought shelter in the harbor. Schooner "Maine" dragged her anchor and was driven ashore near the harbor piers at 4 a. m. on the 23d. The vessel will be a total loss, but the crew was rescued by the Life-saving Service. Another gale began at 2.06 p. m. and continued until 7.10 p. m. on the 23d; maximum velocity, forty-eight miles from the northwest, occurred at 4.22 p. m.

Grand Haven, Mich.: brisk southeast, shifting to colder southwest and northwest, winds prevailed during the day up to 4.50 p. m. on the 23d, when the storm attained its maximum velocity, fifty-four miles per hour; light rain began at 7.45 p. m. and changed to sleet at 11 p. m. on the same date. The steam barge "Argonaut," iron-ore laden, from Chicago, blew her signal of distress when about two miles from shore at about 8.30 p. m. on the 23d. The life-saving crew went to her assistance, but, owing to the fury of the gale and high sea, they were unable to render any assistance.

Mackinaw City, Mich.: a gale began 3 a. m. on the 23d and ended 7.42 a. m. on the 24th; the maximum velocity of wind, fifty-seven miles per hour, from the east, occurred 5.05 p. m. on the 23d. Another gale occurred from 8.45 p. m. of the 24th to 3.04 a. m. on the following day. It reached a maximum velocity of thirty-two miles per hour from the west at 10.36 p. m.

Marquette, Mich.: a severe wind storm, accompanied by a heavy fall of snow, set in 7.08 a. m. on the 23d; the water in Lake Superior was very rough, the waves reaching a height of from fifteen to twenty feet. A maximum wind-velocity of thirty-two miles per hour, from the east, was registered 10.06 a. m., and from the northeast at 12.68 p. m. The schooner "Geo. Sherman" became a total wreck on the south shore of Shot Point, twelve miles from Marquette, and the schooner "Alva Bradley" ran ashore near this city, but was saved by the Life Saving Service from Houghton; both schooners were laden with coal; loss about \$12,000.

Port Huron, Mich.: a severe gale began 5.10 p. m. on the 23d and ended 9.15 a. m. on the following day. A maximum velocity of fifty-five miles per hour from the southwest was recorded at 8.40 p. m. on the 23d.

Lansing, Mich.: a brisk southwest wind, shifting to south, prevailed during the forenoon of the 23d. At 3.30 p. m. the wind increased in force, reaching a maximum velocity of forty-two miles per hour, from the southwest, at 7.50 p. m., and continued high until midnight. From 6 to 10 p. m. the wind averaged over thirty miles per hour.

Toledo, Ohio: fresh to brisk winds prevailed, at intervals, during the 23d. At 1.30 p. m. it increased in force and remained high during the afternoon, reaching a maximum velocity of forty-four miles per hour, from the west, at 9.40 p. m.; at midnight the gale calmed down to twenty-five miles per hour. The three-masted schooner "Zach. Chandler" ran ashore at 10 p. m., opposite Noble Station, near this port; she was bound from Ashtabula to Escanaba, with coal; no loss of life.

Columbus, Ohio: a severe wind storm began 1.50 p. m. on the 23d, heavy gusts of wind tore over the city, carrying away roofs, signs, fences, and breaking hundreds of panes of window glass. At 5.15 p. m., while the gale was at its height, the Welsh Congregational church, a new and substantial structure, collapsed and became a total wreck; the loss is estimated at \$20,000. Several persons were injured by flying debris; maximum velocity of the wind, forty-eight miles per hour from the south, at 5.15 p. m.; the gale ended at 12.30 a. m. on the following day.

Erie, Pa.: unusually high winds prevailed during the day of the 24th, reaching a maximum velocity of forty-eight miles per hour at 1.25 a. m. on the 25th. Steam barge "J. S. Fay," of Cleveland, loaded with coal, became disabled by the rough sea, but was saved by the Life Saving Service. It is reported that the damage to vessels during the storm was very large.

Buffalo, N. Y.: an unusually destructive storm began during the night of the 23d-24th, the wind reaching a velocity of sixty-six miles per hour at 1 and 2.40 a. m., respectively. From 1 to 3 a. m. the wind record registered one hundred and fourteen miles, averaging fifty-seven miles per hour for two full hours, and from midnight until 6 a. m. an average velocity of fifty miles per hour had been recorded. The high wind caused considerable damage in the city, trees from twelve to fifteen inches in diameter were blown down; the streets were strewn with signs, fences, shutters, telegraph and telephone wires and poles; skylights, show-cases, and windows suffered seriously from the gale. A house in course of construction was blown down at 3.20 a. m., but no one was hurt. Captains, owners of vessels, insurance men, and others, acknowledged the great service rendered by the Signal Service in giving timely warning. Not a vessel of any kind left the port from 10 a. m. on Sunday the 23d until sundown on Monday the 24th. The disasters on Lake Erie were very numerous.

Oswego, N. Y.: a severe storm began at 10.30 p. m. on the 24th and increased steadily in force until 5.23 a. m., when a velocity of fifty-three miles per hour, from the west, was recorded; the storm ended at 8.10 p. m. No vessel left the port during the storm. Schooner "Annie Minnies" arrived at about 8 a. m. with her sails damaged. Trees and fences, and a new building used as a carpenter shop, were blown down.

Lunenburg, Vt.: high wind prevailed from 10 a. m. until 1 p. m. on the 24th. Numerous trees were blown down, and some damage was done to fences and buildings.

Boston, Mass.: brisk southwest winds, changing to west, prevailed during the forenoon on the 24th, reaching a maximum of forty miles per hour from the southwest at 12.10 p. m., after which time the wind gradually moderated.

MONTREAL, October 24th.—The severest gale ever known here has been blowing for the last twelve hours. At 2.30 o'clock it was blowing at eighty miles an hour. Four houses were blown down on St. Dominique street, and a block of forty houses was destroyed by fire. In St. Jean Baptiste ward large trees have been rooted up, walls and fences blown down, and considerable damage done.—*Chicago Daily News.*

NEWPORT, R. I., October 24th.—Intelligence was received here this morning that the United States training ship "Portsmouth," which left here yesterday morning, is on Point Judith with four anchors out. The wind is blowing a gale from the southwest directly on shore, and if the gale continues the ship can hardly escape going ashore, with a large loss of life, as the point is a dangerous one, and there are several hundred souls on board. [Later.] The imperiled schoolship was not the "Portsmouth," but the "Saratoga." The wind got around to the northwest and the "Saratoga" got up anchor and started for New York.—*Portland (Me.) Argus, October 24th.*

PROVINCETOWN, MASS., October 24th.—Wind westerly here to-day, blowing fifty miles an hour. The mackerel fleet all returned for a harbor.

SANDWICH, MASS., October 24th.—A regular equinoctial gale has prevailed from the southwest over the Cape since 3 o'clock. No damage reported as yet on the upper end of the Cape. The gale is the severest this season.—*Portland (Me.) Argus, October 25th.*

IX.—The low area which for about thirty-two hours seemed to have been either approaching or developing in the British Possessions to the north of Montana had on the afternoon of the 27th apparently formed a nucleus on the mountain slope, near the sources of the Saskatchewan. Within the next eight hours the centre of the depression moved rapidly a little south of east and, trending afterwards more to the south, entered northern Minnesota and advanced southeastward towards the eastern coast of Lake Erie, where it arrived on the morning of the 29th. Changing direction subsequently to the northeast, it passed, with increased velocity, during the next sixteen hours through northern New England and New Brunswick into the Gulf of Saint Lawrence. The central pressure of this low area was but slightly below the normal during its entire path, but after reaching the vicinity of the Lakes it was succeeded by a

high area rapidly advancing in its rear which considerably accelerated its motion and, as the equilibrium of pressure was still further impaired by a low area on the southeastern coast, the gradients over the Lakes became close, and heavy local gales again prevailed on the 28th and 29th in that region. Local rains and snows also attended the passage of this depression and further increased the dangers of navigation on the Lakes. The movement of this low area across the country was very rapid, its path, of about 2,700 miles, having been traversed at an average speed of about 48.2 miles per hour.

X.—The low area which had for several days been indicated as in the Gulf of Mexico, beyond the limits of observation of adjacent coast stations, was on the morning of the 29th approximately located off the southwestern coast of Florida, about two hundred miles to the northwest of Key West. Local rains had been frequent in the Rio Grande Valley, Gulf States, and Florida since the 24th. A high area was now advancing southward near the Mississippi. Crossing the Florida Peninsula during the next eight hours the centre of the disturbance trended more to the northward and, moving approximately parallel with the coast and at a comparatively short distance from it, progressed northeastward. The rains in the Gulf ceased after its advance into the Atlantic, but extended northeastward along the coast as the disturbance moved in that direction. It apparently increased in energy during translation and was accompanied by heavy gales, especially on the coasts of North Carolina and Virginia. In the vicinity of Norfolk, Va., the storm seems to have been especially severe on the 31st and to have caused much general damage. At the last report of the month the depression was apparently central off the coasts of Delaware and Maryland. Its energy was perhaps at its maximum when off the Virginia coast on the afternoon of the 31st. The pressure at that time at Norfolk was .56 below the normal, but was probably much less nearer the centre.

Observers in North Carolina and Virginia make the following reports regarding this storm:

Hatteras, N. C.: a storm began 4.05 a. m. and ended 2.20 p. m. on the 31st; a maximum velocity of fifty-four miles per hour from the north was recorded at 4.22 a. m.

Kitty Hawk, N. C.: rainy and brisk northerly winds becoming high, with a maximum velocity of sixty miles per hour, at 10.15 p. m. on the

30th. A severe rain and wind storm prevailed until 2 p. m. on the 31st, and for seven hours, from 4 until 11 a. m., the wind velocities averaged over sixty miles an hour; at 10 a. m. the storm attained its greatest force, the wind then reaching a velocity of seventy miles per hour. Considering the severity of the storm, very little damage was done in this vicinity.

Lenoir, N. C.: light rain prevailed at 8 a. m. on the 30th, it was accompanied by hail for a short time in the afternoon, and a few flakes of snow fell.

Raleigh, N. C.: a heavy rain storm began during the night of the 30-31st and continued until 1.10 p. m., when hail fell for about ten minutes. It again turned to heavy rain and was accompanied by snow from 6.80 to 8.30 p. m., when heavy rain set in anew and ended at 10 p. m., 4.18 inches of rain and melted snow having fallen during the prevalence of the storm.

Chicamiconico, N. C.: a heavy gale from the east, accompanied by a few claps of thunder, prevailed during the early morning of the 31st. The storm prostrated several telegraph poles on Body Island and south of Little Kinna-keet, cutting off telegraphic communication.

Cape Henry, Va.: a violent wind, rain, and sand storm prevailed during the day of the 31st. During the storm four schooners were driven ashore at different points between this place and Dam Rock, Va., and many vessels around the capes are still in danger; two lives are reported to have been lost. The wires between this point and Norfolk are in trouble and communication cut off.

Norfolk, Va.: a northerly gale prevailed throughout the day of the 31st, attaining a maximum velocity of forty miles per hour from the northeast. The gale is said to have been of longer duration and caused more damage than any storm since the memorable August gale in 1879. A number of vessels were blown ashore and became total wrecks. The captain and one man of the schooner "Manantico" were drowned. On account of heavy rains and high tides, much merchandise has been damaged or destroyed by water.

XI.—A slight depression was observed in the western Saskatchewan valley on the afternoon of the 29th. Although the barometer was but little below the normal, yet the pressure had decreased nearly .3 in that vicinity during the previous eight hours, and a high area, about .6 above the normal, then existed west of Lake Superior. This low area advanced south-eastward through the valley, reached the lakes north of Manitoba on the afternoon of the 30th, and thence passed eastward into the British Possessions beyond the field of observation. The high pressure which had meanwhile moved southward probably modified its path and forced it farther to the northward. A low area was observed near the mouth of the Saint Lawrence on the afternoon of the 31st and still remained in that vicinity at the close of the month. This is believed to have been the same depression which was last observed near Lake Winnipeg on the 30th, and which had apparently progressed thus far seaward.

NORTH ATLANTIC STORMS.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

MOVEMENTS OF HIGH BAROMETER AREAS OVER THE NORTH ATLANTIC OCEAN.

In the preparation of the following discussion, by Sergeant E. B. Garriott, Signal Corps, daily charts for 1885, containing data from international simultaneous observations taken at noon, Greenwich mean time, have been carefully studied, with a view of determining the general movement of anti-cyclones over the north Atlantic:

The scientific methods pursued by the Signal Service during the past few years in the study of marine meteorology have resulted in deducing facts relative to the movements of ocean storms, whose practical value can hardly be over-estimated. These deductions, while to a considerable degree verifying the results of old observations taken and collected by individuals, have, by their wider scope, and in view of the increased facilities afforded by a systematic series of simultaneous meteorological observations taken by hundreds of ship-masters, permitted a more accurate definition of the general laws which attend atmospheric changes over the north Atlantic Ocean. In connection with the current work of the Signal Office, the cyclonic depressions which appeared over the north Atlantic Ocean have been traced and described, and their general characteristics as regards direction and velocity of movement, frequency, and distribution, have been fairly well determined. This work has been necessarily performed in a very limited time, and is, therefore, lacking in details as to the causes which seemed to contribute to the normal and abnormal movements of cyclones. Further labor and judgment will therefore be needed to extract from the invaluable accumulation of data on file the facts that will lead up to a clearer understanding of the laws governing storm movements on the north Atlantic.

In an article entitled "North Atlantic storms during 1885," which appeared

in the MONTHLY WEATHER REVIEW for July, 1887, the apparent dependence of a cyclone's movement upon its position with reference to anti-cyclonic areas was briefly discussed, and it was shown by a tabulated statement that during periods of high barometric pressure over mid-ocean north of the fortieth parallel, storm-areas do not follow the usual east-northeast course to European waters, but pursue a more northerly track, or disperse.

As areas of high barometric pressure influence to a greater or less degree the movements of low barometer areas, and as the anti-cyclonic and cyclonic areas are chiefly and conjointly instrumental in producing all atmospheric changes, it would seem that investigations tending to produce facts relative to the movements of anti-cyclones over the Atlantic would be of interest when considered in connection with the movements of cyclonic areas, and of value in determining the laws and conditions which govern weather changes in the great highways of the ocean.

The series of international observations show that an accumulation of air exhibiting an anti-cyclonic circulation is commonly located over mid-ocean south of the fortieth parallel, and that a barometric depression usually occupies the ocean north of the fiftieth parallel. The storm-track charts also show that the normal direction of movement of cyclonic areas in any given locality corresponds closely with the prevailing wind-directions in that locality, which are governed over the ocean by the anti-cyclonic and cyclonic systems referred to. It has been found that in their passage from the North American continent areas of high and low barometric pressure follow one another with a great degree of regularity, and that while areas of low pressure have a normal north of east course after leaving the coast, the high pressure areas almost invariably move south of east. The normal direction of movement of cyclonic areas in the trans-Atlantic tracks is evidently due to the prevailing drift of the atmosphere in the vicinity of the fiftieth parallel, along the line of which is the intermediate region between what may be termed the permanent areas of high and low mean barometric pressure, under the combined influence of which the